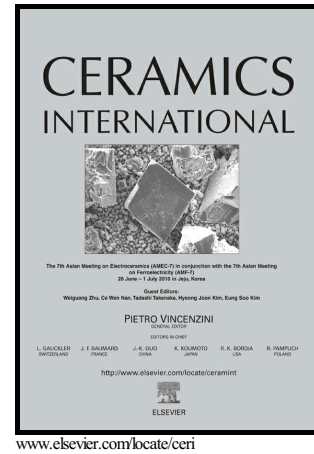


Author's Accepted Manuscript

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PII: S0272-8842(18)31066-6
DOI: <https://doi.org/10.1016/j.ceramint.2018.04.194>
Reference: CER118111

To appear in: *Ceramics International*

Received date: 14 February 2018
Revised date: 21 April 2018
Accepted date: 21 April 2018

Cite this article as: Manel ben Abdessalem, Issa Kriaa, Abdelhedi Aydi and Najmeddine Abdelmoula, Large electrocaloric effect in lead-free $Ba_{1-x}Ca_xTi_{1-y}Zr_yO_3$ ceramics under strong electric field at room-temperature, *Ceramics International*, <https://doi.org/10.1016/j.ceramint.2018.04.194>

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Large electrocaloric effect in lead-free $\text{Ba}_{1-x}\text{Ca}_x\text{Ti}_{1-y}\text{Zr}_y\text{O}_3$ ceramics under strong electric field at room-temperature

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Abstract

In this study, lead-free $\text{Ba}_{1-x}\text{Ca}_x\text{Zr}_y\text{Ti}_{1-y}\text{O}_3$ (BCTZ(x, y)) ceramics were prepared by means of the classic solid-state reaction method. The morphotropic phase transition (MPB) from the orthorhombic to the tetragonal phase (O-T) was identified in this composition. Besides, the identification of those two structures at room temperature (RT) was made possible thanks to an X-ray diffraction (XRD) study. In order to determine the phase transitions dielectric measurements were conducted. Based on Maxwell equation, the electrocaloric (EC) effect in the studied ceramics was performed via the indirect method. The compositions gave maximum EC temperature changes (ΔT) at above their T_C on application of a 3 kV/mm electric field. These temperature changes are $\Delta T=0.565\text{K}$ at $T_{EC}=392\text{K}$, $\Delta T=0.548\text{K}$ at $T_{EC}=365\text{K}$ and $\Delta T=0.235\text{K}$ at $T_{EC}=307\text{K}$ for BCZT(10%,5%), BCZT(13%,10%) and BCZT(20%,15%), respectively. At RT, these compositions provided a very interesting EC coefficient ($\zeta = \Delta T/\Delta E$) compared to the pure BaTiO_3 (BT). These values, lying between 0.105 Kmm/kV and 0.188Kmm/kV for $\Delta E = 3$ kV/mm, are also greater than those related to some lead-based ferroelectric.

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